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ELECTRICAL ENERGY FROM LIVE LOADS USING A BOURDON TUBE

Background.

1. Field of the Invention.

This invention concerns converting pressure variations into electrical energy and more particularly through the agency of a Bourdon tube which first converts pressure variations into kinetic energy.

2. Prior Art.

Piezoelectric inventions convert pressure variations directly into electrical energy but their efficiency is very low and charging piezoelectric material is expensive.

Bourdon tubes that transmit power have been proposed (see U.S. Patent 2850870 and JP362284970A) but these have used heat to create a pressure differential to operate a mechanical device.

Patent application #10/263,451 filed 10/3/02 is an example of converting the energy in a live load into electrical energy through the agency of a Bourdon tube. The cause of this live load is ocean waves acting on a stable body in the ocean. Up to now in order to convert live loads into electrical energy that part of the conversion apparatus which receives the live load has been set in motion next to the live load. These live loads often exist where rigidity of structure is needed. (See U.S. Pat. 6,376,925 to Galich and U.S. Pat. 4,004,422 to LeVan). Here, a section of roadway

is made moveable so as vehicles ride over it the resulting kinetic energy may be converted into electrical energy. Introducing moving parts into a structure subject to the elements makes that structure more impractical.

Reference is also made to my Disclosure Document #545543.

GENERAL SUMMARY

A live load is defined in this invention as any load causing variation in pressure through time on the walls of a reservoir of working fluid. There are many causes of live loads and the energy of them can be converted into electrical energy using a Bourdon tube.Changes in structure are needed for each type of cause. This invention is concerned with describing these various structures.

Basically the invention is a reservoir of working fluid impacted by a live load, a Bourdon tube, certain gearing and a D.C. generator, all operatively connected. The relatively inelastic walls of the reservoir are pressed upon by various causes. The working fluid may be compressed and decompressed or spun to create pressure variations in the Bourdon tube. The Bourdon tube is made to act on the gearing so as to activate the generator.

The aim of the invention is to convert pressure energy to electrical energy yet not impair the integrity of the supporting structure by introducing moving parts,nor use heat to produce the needed pressure. Heat can be more effectively be conveeted into pressure energy in other ways well known.

Further objects and aims of the invention will become apparent from the study of the following portions of the specification, the claims and the attached drawings.

BRIEF DESCRIPTION OF THE DRAWINGS.

FIG.1 is a perspective of an apparatus for transmitting live loads to a Bourdon tube.

FIG.2 is a perspective of prior art showing a twist type Bourdon tube operably connected to an electric generator.

FIG.3 is like FIG.2 but substitutes a C-type Bourdon tube.

FIG.4 shows how the invention converts the energy of a live load on a roadway into electrical energy.

FIG.5 shows a structure where the wind presses on the reservoir of the invention.

FIG.5a is a cross-section of a device showing how a pole may be used as a lever to transmit pressure variations to a Bourdon tube.

FIG. 6 shows how a tree may be used with the invention to produce electricity.

FIG.7 shows how a building may be used with the invention to produce electricity.

FIG.8 shows how a sailboat may be used with the invention to produce electricity.

FIG.9 shows how an aircraft may be used with the invention to produce electricity.

FIG.10 shows how a bridge may be used with the invention to produce electricity.

FIG;11shows how electric cars/trucks/buses may be used with the invention to produce electricity.

FIG.12 shows how a ship may be used with the invention to produce electricity.

FIG.12a shows more particularly a perspective view of a ship's propeller and the structure of the invention near it.

Fig. 13 shows how a railcar's shock absorber may be used with the invention to produce electricity.

FIG.14 shows how a spinning tire may be used with the invention to produce electricity.

FIG.15 is a perspective view of a device to convert the energy of wind and subsurface ocean currents into electricity using the present invention.

BASIC STRUCTURES OF THE INVENTION

Turning to Fig. 1 we see a hollow cylinder with end pieces as defining a reservoir 1. There is a piston 2 therein dividing the reservoir into two compartments with a shaft 3 extending through the wall of an endpiece. O-ring 9 prevents the working fluid within the cylinder on both sides of piston 3 from leaking out. The working fluid is water under pressure. Another shaft 4 is fixedly attached to cylinder 1 through connection with the other end piece. Two cappable fill-holes 7,8 on either side of piston 2 allow access to the working fluid from the outside. Exit tubes 5,6 are made to allow the transfer of pressure to the rest of the invention. As the bulk modulus of elasticity of water is very high then in operation the piston will have no significant motion. But as force is applied to the piston there will be caused a pressure differential on either side of the piston which will be transmitted through tubes 5,6.

In FIG.2 we see tubes 5,6 again. Supports 15,16 contain machinery for converting pressure differentials into kinetic energy to operate a D.C. electric generator 27.

Pipe 6 is made to open into the end of Bourdon tube 11 which is fixedly attached to support 15. The moveable end of Bourdon tube 11 is fixed to spur gear 12 axially mounted on shaft 14 and supported by supports 15,16. Meshing with gear 12 is gear 17 mounted on driveshaft 26. Pawl 10 is operatively attached to gear 17. Ratchet 19 is fixed to shaft 26. Supports 15,16 also support shaft 25. Gear 18 with operatively attached pawl 22 is mounted on shaft 25. Ratchet 21 is fixedly attached to shaft 25. Ratchet 21 and pawl 22 are set to be made to operate in the

opposite direction from ratchet 19 and pawl 10 operatively attached to gear 25. Axially attached to driveshaft 25 is gear 29 which is located to mesh with gear 23 which is axially attached to shaft 26. The working fluid for Bourdon tube 11 is water except for the twelfth preferred embodiment where it is air. Fixedly attached to support 15 is chamber 13 which encloses Bourdon tube 11. Chamber 13 is attached to a face of gear 12 by a slideable seal 13a so as gear 12 is made to revolve the working fluid within chamber 13 will be retained. Entry tube 5 is located to supply pressure to the working fluid within chamber 13.

In operation pressure variations on the working fluid in Bourdon tube 11 and chamber 13 cause gear 12 to be rotated back and forth. Due to the action of the aforementioned gears 12,17,23,29 and ratchets 19,21 and pawls 10 ,22 driveshaft 26 is made to rotate in only one direction regardless of the direction gear 12 is made to rotate. Driveshaft 26 thus is made to operate generator 27.

Turning to FIG.3 we see the apparatus of Fig. 2 modified for a C-type Bourdon tube 28. On the moveable end of Bourdon tube 28 is a rod which is made to fit into Scotch Yoke 24 fixedly attached to gear 12. Regardless of which type of Bourdon tube is used if it is desired to increase the force on gear 12 then a plurality of Bourdon tubes can be attached to gear 12. A possible arrangement is shown in U.S. Patent 1,258,368.

SUMMARY AND DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS.

First Preferred Embodiment.

The reservoir is completely filled with water and installed under the asphalt covering of a roadway. The rest of the invention is located above ground elsewhere with the Bourdon tube connected to the reservoir by a tube.Thus when a vehicle is driven over the reservoir the invention is operated.Water is very hard to compress and since the reservoir is completely filled there is no significant deforming of the asphalt.

Second Preferred Embodiment.

This is like the first embodiment except the invention is applied to a walkway. Instead of an asphalt covering there is a plywood sheet with a rug on top. Under the reservoir is a wooden subflooring to support the reservoir and wood blocking the depth of the reservoir between the subflooring and plywood sheet around all sides of the reservoir.So then when the rug over the reservoir is walked on pressure variations are transmitted to the Bourdon tube and the invention is operated.

FIG.4 shows an asphalt roadway 30. Buried under the roadway is a stainless steel reservoir completely filled with water 32. on top of reservoir 32 is stainless steel channel 31 with both legs resting on the top surface of reservoir 32. Tube 33 is led from reservoir 32 is joined to tube 6 to supply pressure variations to Bourdon tube 11. In this embodiment no chamber 13 or tube 5 is needed Item

34 denotes the normal underfill of an asphalt roadway. This apparatus may also apply to a walkway where a rug over a plywood sheet is denoted 30, There is a wood subflooring 34and wood blocking surrounding reservoir 32 (not shown) . the depth of reservoir 32.

5. Third Preferred Embodiment.

There is a pole rising vertically from the ground with a revolveable sail on top. The pole's root is extended a short distance below ground level. At ground level the pole is surrounded by a pivot. Below ground level there are four reservoirs extending 90 degrees from each other horizontally. The piston shafts are all attached to the pole at its end. When wind presses on the sail the pole tends to sway and act as a lever,causing pressure differences in at least four of the chambers thus activating the invention.

FIG.5 shows pole 35 in two sections with rotateable joint 37 between them. Affixed to the upper section is sail 36. Pole 35 is extended a short distance below ground level,shown in FIG. 5a.Concrete form 38 is formed to form a pivot for pole 35 and to contain certain conversion machinery as in FIGS.1, . Joint 39 fixes piston shaft 2 to pole 35 through wall 40. Piston 3 is within water-filled cylinder 1. Exit tubes 5,6 are shown and are led to Bourdon tube 11 and chamber 13 as previously noted.

In operation pressure on sail 36 causes pole 35 to act as a lever activating the conversion machinery and producing electricity.

Fourth Preferred Embodiment.

This is like the third preferred embodiment but here the pole is tied at its top to the trunk or the branches of a tree. The leaves and branches of the tree substitute for the sail.

FIG.6 shows a palm tree 41with a pole 42 rising parallel to the trunk . The top of pole 42 is tied to the tree 41. The structure at the bottom of pole 42 is identical to the structure of Fig.5a. In operation wind pressing on the leaves and branches of tree 41 causes pole 42 to act as a lever as described for FIGS. 5,5a, producing electrical energy through the agency of the conversion apparatus.

Fifth Preferred Embodiment.

This is also like the third preferred embodiment but the pole is surrounded by a tall building which serves as a sail.The pole is only attached to the building framework at the roof level.So as the building is made to sway by the wind the invention is activated.

FIG.7 shows a tall building 43. Pole 42 is erected from the structure of FIG. 5a located within the foundation of building 43.Pole 42 is only attached to building 43 at the roof which is covered by plate 62 which is fixedly attached to the framework of building 43. In operation building 43 acts as a sail in the wind causing pole 42 to act as a lever. This activated the conversion machinery of the invention to produce electrical energy.

Sixth Preferred Embodiment..

Here the pole is a mast of a sailboat.The invention is also applied to the running and standing rigging of the vessel. The aformentioned piston shaft is attached to the hull and the piston cylinder is attached to a rope of the standing or running rigging.So as wind presses on the sails in its usual ever-changeing way the invention is activated and produces auxiliary power for the boat.

FIG.8 shows pole 42 as a mast on a sailboat.The rest of the invention is installed inside the hull.For running rigging 64 and standing rigging 63 the machinery shown in FIG.1 is used instead of the machinery of FIG.5a.

In operation as wind is made to press against the sails,electrical energy may be supplied to a battery for auxiliary power. Substituting a battery for ballast is prior art.

Seventh Preferred Embodiment.

In this embodiment the reservoir takes the shape of a double-walled container within a car,bus or truck.The container may contain fuel,a battery or other cargo.Only the outer wall is fixed to the frame of the vehicle.The weight of the inner wall and its contents is supported in various directions by the reservoir structure described in the section on the third preferred embodiment.So as the vehicle is made to change its momentum the tendency of the weight inside the inner wall of the container to shift position will activate the invention.

FIG.11 shows a container within a vehicle which may contain a mass 70 . Container 70 is enclosed by another container 44 which is fixedly attached to the framework of the vehicle. Between these containers are a number of the structure of FIG.1.Shaft 4 is fixedly attached to container 44 and shaft 3 is made to terminate as a ball bearing 45 which rides on the outer surface of container 70 .

In operation as the mass of container 70 and its contents acquire a different momentum than the vehicle frame due to the impact of live loads the machinery of the invention is activated to convert kinetic energy into electrical energy. The contents of container 70 may be fuel,a battery or cargo.

Eighth Preferred Embodiment.

In an aircraft there is a great deal of turbulent drag behind the wingtips and jet exhaust hole of an aircraft as well as behind a a ship's propeller. As in the third preferred embodiment there is a pole extending from inside the wingtip/fuselage/hull aft through the rear surface and a measured distance beyond these structures.Fixedly attached to the rear of the pole is a rudde The aforementioned pivot is located at the surface of these structures and the rest of the invention is within the wingtip/fuselage/hull.Forward motion of the aircraft/ship will cause the pole to flutter and activate the rest of the invention producing auxiliary power for the aircraft/ship.

FIG.9 shows a wingtip of an aircraft 47. From the rear of the wingtip is extended pole 42 terminating in a rudder 65.There is located a pivot 38 affixed to the airfoil frame. The root of pole 42 is attached to shaft 4 of FIG.1. The rest of the conversion machinery of the invention is attached directly to the aircraft fuselage.

In operation as the aircraft is made to travel forward the turbulence behind the wingtip caused by aerodynamic drag causes rudder 65 and pole 42 to flutter, operating the invention and producing auxiliary power for the aircraft 47.

FIG. 12a is like FIG.9 with similar parts numbered identically but the invention's force collection apparatus is located near a ship's propeller.

Ninth Preferred Embodiment.

The invention is structured like the third preferred embodiment but here the reservoir is in one case laid horizontally on top of the keel with with the piston shaft fixedly attached by cable to the fore end of the keel and the piston cylinder fixedly attached to the aft end of the keel by a cable.As the keel tends to hog due to the action of the ocean the cables pull the piston cylinder one way and the piston shaft the opposite way. activating the invention. In another case one cable may be connected to the top of a frame on one side of the ship and diagonally to the

bottom of the same frame on the other side of the ship. So as the frame tends to rack as the ship is made to roll by the action of the ocean one cable will stretch and activate the invention as in the prior case.

FIG.12 shows a hull of a ship 48 with a keel 49 and cables 46 A machine as in FIG.1 has its shaft 4 attached to a cable 46 and its shaft 3 attached to the hull framing.

In operation as the hull 48 is made to hog or rack the appropriate cables are stretched, activating the conversion machinery of the invention to produce electrical energy.

Tenth Preferred Embodiment.

This embodiment refers to the support structure for shock absorbers. These exist between railcars and between the wheels and framework of a railcar or other vehicles as well. By placing the reservoir structure described in the third preferred embodiment between the shock absorber and frame so the piston shaft is connected to the shock absorber piston and the piston cylinder is connected to the vehicle frame then the invention is activated when each railcar has a different momentum or when the vehicle is made to accellerate vertically.

In operation, as shock absorbers 55 are activated by live loads the machinery of the invention is activated to produce electrical energy.

FIG.13 we see railcar 51 with the apparatus of FIGS. 1, 2. In particular the machinery of FIG. 1(shown schematically) has its shafts 3,4 connected to shock absorbers 55 which in their turn are connected to a railcar 51 and also to a succeeding railcar 51.

Eleventh Preferred Embodiment.

Live loads on suspension bridge roadways cause the stress on the suspension cables of the bridge to vary. By inserting the reservoir structure described in the third preferred embodiment between two sections of a cable vertically so one section of the cable will pull the piston shaft and the other section will pull the piston cylinder the invention will be activated. The added vertical motion of the cable when subject to an added load will be very small.

FIG.10 shows a bridge 50 suspended by cable 52 from suspension cable 51. A second cable 66 is attached to cable 52 at cable 52 top 53 and bottom 54 so as cable 52 is stretched cable 66 is stretched also. Cable 66 is divided into two sections united by the conversion machinery of FIG.1 uniting the two sections.

In operation as cable 66 is stretched and alternately relaxed by the passage of live loads on bridge 50 The conversion machinery of the invention is activated, producing electrical energy. FIG.1 is shown schematically in Fig. 10.

Twelfth Preferred Embodiment.

This concerns auxiliary power generated by a vehicle's air-inflated tires. When a tire is made to revolve on its wheel

the air in the tire spins also due to friction with the inner walls. Also the air will be forced to the tread wall due to inertia. Therefor there will be a pressure differential with higher pressure at the treadwall (which is the outer circumference of the air compartment)and the wheel wall (which is the inner circumference of the air compartment). For this embodiment two concentric tubes are led through a hole in the middle of the axle from the first gear of a transmission, through the driveshaft, bending 90 degrees at the differential, the first tube terminating just inside the inner circumference of the air compartment so as the tire is made to spin air is drawn out of the tube and lowering the pressure therein.

The second tube is led to the outer circumference of the air compartment and bent in the direction of the tire spin when the vehicle is made to move forward. This second tube terminates on the one hand at the aforementioned outer circumference and on the other end inside the C-type Bourdon tube. The first tube is made to terminate in the chamber surrounding the Bourdon tube. This second tube is made to terminate inside the air cushion so it is fixed in one position as the tire is made to spin. in this way air is forced into the second tube increasing the pressure therein.

In this way the Bourdon tube is made to operate with the maximum pressure differential. Thus the invention is activated when the vehicle is made to accellerate or decellerate. This embodiment is particularly useful to recover energy from operating electric cars.

In FIG.14 we see a vehicle tire 60 mounted on a wheel ridged 85 on i outer perimeter 55 and axle 56.Through the center of axle 56 concentrically is a hole containing two tubes 58,59. Tube 58 is made to terminate inside the air container of tire 60 near the wheel's outer perimeter. Tube 59 is made to terminate near the outer perimeter of the air pocket underneath the tread.Thrust bearings 69,79 mounted around wheel 55 with ball bearings 68,78 are sealed against air pressure.Only the section of tube 59 distal to revolveable seal 61 revolves with wheel 55. From holes in the bottom of thrust bearings 69,79 hang tubes formed as tubes 59,69 respectively. Weights 70,70a are fixedly attached to tubes 59,60 The concentric tubes 80,81 on the other side of revolveable seal 61 are led through differential 82 turned 90 degrees, through drive shaft 83 and the center of transmission gear 84 where they become tubes 5,6.

In operation as tire 54 is made to spin weighted tubed 60,67 remain in the same position so pressure within tubes 6,59,67 and tube 16 as well as Bourdon tube 11 is increased so more energy can be recovered.

Thirteenth Preferred Embodiment.

Wind and subsurface ocean currents, if their velocities are plotted on a second-by-second basis show many variations. For example we observe wind blows in small and large gusts. This produces pressure variations on whatever solid surface these fluids strike. This embodiment shows how these variations may be converted into electrical energy.

Here is shown how to integrate the invention into prior art exhibited in U.S. Patent Application#10/742,983 which concerns the energy of the wind and subsurface ocean currents. In the prior art there is a teardrop-shaped object elevated into the midst of a fluid current. The object is oriented so its blunt end is made to face the oncoming current. The object is in two separate portions , the division being on a plane through the object's widest diameter called an anterior dome and either a posterior cone or a posterior dome. There is sufficient structure to unite the separated parts of the hollow object together. Through the center of the anterior dome shaped portion is a hole. As fluid flows past this teardrop shaped object fluid tends to be drawn through this hole at high velocity and out between the rims of the anterior and posterior portions of the object at the prevailing current velocity. A cone shaped object is placed just inside the anterior portion near the hole so fluid entering the hole will be deflected by the cone. The cone is operably attached to the piston shaft of the structure described in FIG.1

Turning to FIG.15 we see a teardrop shaped hollow object in two portions: an anterior portion 71 and a posterior portion shaped either as a cone 72 in the case of wind being the working fluid or as a dome 73 if subsurface ocean currents are the working fluid. Fins 76 provide sufficient structure to unite the two portions. There are a plurality of these located circumferentially. Cone 74 lies just behind a hole at the front of the object and is operably connected to piston shaft 3 and piston 2 which is enclosed by piston sleeve 1 with its endpieces.Struts 75 hold sleeve 1 and cone 74 in place with dotted lines showing struts braced against the posterior dome.Exit tubes 5,6 are constructed to join the two compartments on either side of piston 2 to Bourdon tube 11 and chamber 13.

In operation as wind or current is made to enter the hole in gusts the cone is impacted causing pressure on piston 2 to vary in time and activate the invention.The working fluid within sleeve 1 and exit tubes 5,6 is water.

From the above description it is apparent that the preferred embodiments achieve the object of the invention.Alternative embodiments and various modifications of the depicted embodiments will be apparent to those skilled in the relevant arts. These and other alternatives are considered to be equivalent and within the spirit and scope of the present invention.